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China Report

SCIENCE AND TECHNOLOGY

No. 88

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NATIONAL DEVELOPMENTS

SCIENTIFIC RESEARCH ON WORLD TIME REPORTED

OW100142 Beijing Xinhua Domestic Service in Chinese 0101 GMT 6 Mar 81

[Excerpts] Beijing, 6 Mar (XINHUA)--XINHUA reporter Gu Mainan reports that since the downfall of the "gang of four," the broad masses of scientific and technical personnel of various institutes under the Chinese Academy of Sciences have made efforts to contribute to socialist construction. According to statistics, they have completed nearly 4,000 scientific research projects, including some 400 major projects, from 1977 to 1980. Quite a few projects reached world advanced levels and received the national awards for inventions and creations.

While serving the national economy and the national defense building, various institutes have also started a number of research projects on basic theories. Universal time, a time system based on the rotation of the earth, is a parameter essential to astronvigation, positioning and geodesic study. A very precise universal time is essential to the precision range finding for extraterrestrial substances, studies of changes in the rotation of the earth and of plate and plate tectonic and the precision tracing and positioning of spacecrafts.

Universal time is determined by synthesizing the surveys of relative movements of celestial bodies and the earth. At present, the world time system of our country is made up of 6 astronomical observatories and stations with 10 sets of instruments. The instruments used at these observatories are capable of measuring the time with precision and stability and have reached the world advanced level.

CSO: 4008

BRIEFS

JIANGSU SCIENCE, TECHNOLOGY CONFERENCE--The Jiangsu Provincial People's Government held a provincial conference on science and technology from 27 February to 6 March in Nanjing. The conference, attended by more than 350 responsible comrades at various levels in charge of science and technology, stressed that the primary task of science and technology was to promote economic development. It called for improving the management of scientific research projects, making rational use of energy sources, developing basic scientific researches and applying scientific findings to production and technology. Zhang Zhongliang and Gong Weizhen, responsible persons of the Provincial CCP Committee and people's government, addressed the conference. Comrade (Zhao Peiyi), chairman of the Provincial Scientific and Technological Commission, delivered a work report. [Nanjing Jiangsu Provincial Service in Mandarin 1100 GMT 6 Mar 81]

SHANGHAI SCIENTIFIC, TECHNOLOGICAL ASSOCIATION--The second committee of the Shanghai Municipal Scientific and Technological Association held its second enlarge session on 7 March. The session pointed out that the association's work this year is to develop science and technology in the service of the four modernizations. Acting Shanghai Mayor Wang Daohan addressed the session, calling on scientific and technological workers to offer suggestions for the present work of economic readjustment by seeking truth from facts. Also present at the session were Yang Shifa, Vice Shanghai Mayor and Chairman of the Municipal Scientific and Technological Commission; and Zhao Zukang, another Vice Mayor of Shanghai. [OW100155 Shanghai City Service in Mandarin 1130 GMT 7 Mar 81]

WOMEN SCIENTISTS--Beijing, 8 Mar (XINHUA)--China now has more than 80,000 woman scientists working in research institutes of natural sciences, accounting for 27 percent of the total number of scientists, according to the State Scientific and Technological Commission. The Chinese Academy of Sciences now boasts 277 woman research fellows and associate research fellows and 4,874 assistant research fellows. Wang Chengshu, now 69 and a woman nuclear physicist known both in China and abroad, is a chief engineer of the Second Ministry of Machine-Building Industry. She has made achievements in researches on controlled thermonuclear fusion reaction and plasma physics and on separation of uranium isotopes. Gao Xiaoxia, a woman professor of Beijing University, has published more than 20 papers on analytical chemistry, analysis of electrochemistry and the instrument for monitoring air pollution. Huang Liang, a woman research fellow in the Institute of Pharmacology under the Chinese Academy of Medical Sciences, has guided the extraction and synthesis of anti-cancer drugs. [Text] [OW090028 Beijing XINHUA in English 1206 GMT 8 Mar 81]

CSO: 4020

APPLIED SCIENCES

CHINESE ICBM LAUNCH REPORTED

Beijing XIANDAIHUA [MODERNIZATION] in Chinese No 8, 16 Aug 80 inside front cover, pp 1, 11

[Article by Liu Shaoqiu [0491 4801 3808] and Li Xianlin [2621 7341 7207]: "This Is What an Intercontinental Ballistic Missile Is Like"]

[Text] On the morning of 18 May 1980, our country successfully launched its first delivery vehicle to a predetermined area of the Pacific Ocean (Fig. 1) [not reproduced]. This marked our country's attainment of a new level in delivery rocket technology; it was of great significance in accelerating implementation of the four modernizations, strengthening our defense capabilities and dealing with the threat of hegemonism.

The delivery vehicle was a rocket used to launch such spacecraft as satellites, spaceships and interstellar probes, as well as conventional and nuclear warheads. The delivery vehicle and its warhead together are called a ballistic missile. Ballistic missiles are classified in terms of their range as: short range missiles, with ranges of 1,000 km or less; medium range missiles with ranges of 1,000 to 4,000 km; long-range missiles, with ranges of 4,000 to 8,000 km; and intercontinental ballistic missiles [ICBM], with ranges of over 8,000 km.

Because the intercontinental ballistic missile has long range, great striking power and high speed, climbs fast and strikes accurately, and can carry out a sudden attack on the enemy, penetrate his defenses and destroy important objectives, it is an important strategic weapon. The delivery rocket used in the test was a multistage rocket. When the first stage finished operating, the second stage began to function, and so on, as in a relay race, in order to achieve the required speed and position.

How a Ballistic Missile Flies to Its Target

A ballistic missile is a craft which does not need a pilot and has no wings. It follows a predetermined path (trajectory) and impacts at a predetermined location. Its trajectory is generally divided into two stages: the active and passive legs stage. Fig. 2 is a diagram of the trajectory of a multistage missile. The first stage, between ignition and burnout, is called the active stage of the trajectory. During this part of the trajectory the missile is propelled by its engines and flies under the control of the control system.

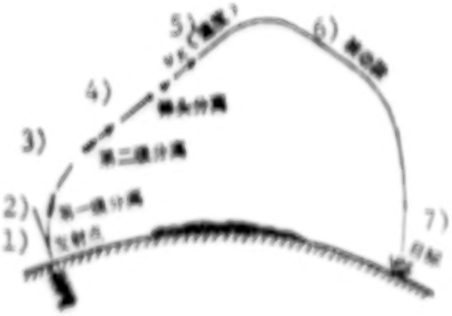


Fig. 2. Trajectory of multistage ballistic missile

Key:
1. Launch point
2. First stage separates
3. Second stage separates
4. Warhead separates
5. Velocity
6. Passive stage
7. Target

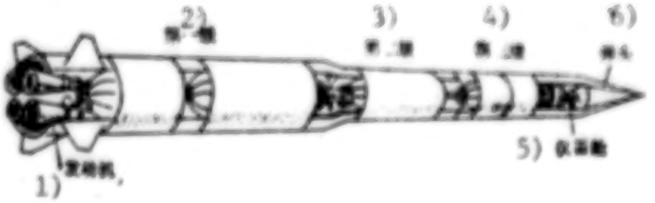
The missile first flies vertically, then turns and flies on a predetermined (programmed) trajectory until its location and speed are such that it can strike its target, at which time the rocket motor ceases to burn and the nose section separates from the missile and begins the passive stage of the trajectory.

During the passive stage, the nose section flies on a free trajectory toward its target by virtue of its momentum like a projectile shot from a gun barrel. Most of this stage is outside the atmosphere. Because the nose section is affected only by the earth's attractive force, the trajectory becomes elliptical. The nose section flies until it is about 80 kilometers from the earth's surface, then begins to reenter the atmosphere. The stage of the trajectory between the nose section's reentry into the atmosphere and its ground impact is called the reentry stage. In this stage, the warhead flies toward its target at more than 20 times the speed of sound. The length of the passive stage is about 90 percent of the total distance flown. An intercontinental ballistic missile flies as high as 1,000-2,000 km. Its flight takes more than 30 minutes and its speed is more than 7 km per second.

The missile's range is determined by its speed and angle of inclination (the angle between its velocity vector and the local horizontal) at burnout. Deviations in burnout velocity and angle of inclination have a great effect on the missile's accuracy. For example, if a 10,000-km range intercontinental ballistic missile has a burnout velocity deviation of 1 meter per second (about 1/10,000th of the velocity at burnout), this will result in a deviation of 6-7 km in the point of impact. Accordingly the burnout point must be carefully controlled.

Basic Structure of a Ballistic Missile

Ballistic missiles generally consist of a nose section, a propulsion system, a flight control system and the projectile. Fig. 3 shows a multistage ballistic missile.



Key:
1. Engines
2. First stage
3. Second stage
4. Third stage
5. Instrument compartment
6. Warhead

Fig. 3. Multistage ballistic missile

The nose section destroys the enemy target. An ICBM with a nuclear weapon in the nose section has a rather large destructive capability. The propulsion system (also called the power system) produces the thrust which moves the missile, as a locomotive does. Ballistic missiles use solid-fuel or liquid-fuel engines. Solid-fuel missiles, using solid-fuel rocket engines, are more convenient and maneuverable than liquid-fuel missiles and require a shorter launch preparation time.

The flight control system assures that the missile will fly stably on the preselected trajectory and will hit the target accurately; it resembles a capable pilot.

Development of a ballistic missile requires repeated testing to finalize the design. Because of the long range of intercontinental ballistic missiles (over 8,000 km), countries cannot find suitable impact points on land, and accordingly all missiles use the open sea, so that the nose section (carrying various types of measuring equipment) splashes down into the ocean.

In the full-range test the delivery rocket, with its nose section carrying telemetry equipment, tests such design parameters as range and impact accuracy, the reliability of the delivery rocket's systems and components and the like. With a delivery vehicle of excellent capabilities and high accuracy, if an enemy should start a war, it would be possible to use a sufficiently accurate intercontinental ballistic missile to deal with the enemy and to protect the security of our homeland.

History and Prospects

The ballistic missile has developed since the second World War on the basis of the German V-2. The United States and the Soviet Union have already tested three generations. The third generation was successfully tested and made operational in the 1960's; it includes the U.S. Minuteman IV [as published] and the Soviet SS-9, SS-17 and SS-19. The main characteristic of this generation of ICBM's is the use of multiple warheads. Currently foreign countries are developing a new generation of ICBM's with high maneuverability, accuracy and survivability.

Future missiles' survivability, their capability to penetrate defenses, i.e. to break through ballistic missile interception, and their accuracy are still being improved.

To improve survivability, first the missiles will be concealed to make it difficult for the enemy to discover them; second, their underground silos will be hardened to improve their ability to withstand a nuclear explosion; and third, the missiles will be maneuverable in storage and launching. Current trends are toward maneuverability: some missiles are being placed under the ocean, with the development of surface-to-surface ballistic missiles launched from nuclear-powered ballistic-missile submarines; some are being put in the sky, i.e., are launched from midair; and some are maneuverable on the ground surface. Surface maneuverability is relatively easy to implement and is relatively inexpensive; an example is the fourth-generation MX intercontinental ballistic missile being developed by the United States, in which the racetrack form of maneuverability will be used.

As antiballistic missile weapons are continuously improved and developed, ICBM's will have to have increased penetration capabilities. The multiple warhead technology currently in extensive use is one example. The newest type is warheads which have individual propulsion and control systems, enabling them to change their trajectories and maneuver in flight, and which use terminal guidance to hit their targets accurately.

In the 30-odd years since the appearance of the ballistic missile, it has developed extremely rapidly. The V-2 was accurate to within 8 km, while current missiles' accuracy has been improved to within several hundred meters, so that a warhead can destroy an enemy guided missile silo.

a)

b)

c)

d)

e)

PHOTO CAPTIONS

(a) Fueling crew intensely at work

(b) Our country's delivery rocket, launched toward a preselected point in the Pacific Ocean, lifts off.

(c) Before the launch, measurement systems at the launch sitetake data readings.

(d) Assuring that the radar antenna tracking movement operates normally and will correctly acquire its objective.

(e) Ground monitoring and control systems give timely reports on the rocket's flight.

8480
CSO: 4008

APPLIED SCIENCES

MATHEMATICAL MODEL FOR STAR SCENE SIMULATION DEVELOPED

Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 1, 1980 pp 85-93

[Article by Xu Lin [1776 3829] of the Institute of Space Medicine and Engineering: "The Mathematical Model for Visual Simulation of Star Scene in Space-flight"]

[Text] Abstract

(Received 14 November 1979)

The accurate and realistic visual simulation of the star scene in astronauts' training for manned-space-flight helps the astronauts in judging the spacecraft orientation and the orbital coordinates with respect to the star positions and in realizing spacecraft maneuvering.

In this paper the problem of visual simulation of the star scene in space-flight training is discussed. A method for star scene simulation by means of a planetarium is presented and a mathematical model is applied to control the motion of the planetarium with a computer in real-time, the astronauts in the cockpit will see the exact and accurate star scene in simulated orbital flight.

Introduction

In the rapid developments of aeronautics and astronautics, flight simulators are powerful tools in the training of pilots and astronauts from economic and reliability considerations as well as from the efficiency and practical points of view. Early simulators often had only instrumental display simulation in the cockpit. With the needs of enhancing the sense of reality in the simulation for high quality flight training and research, increasing attention has been placed on the vivid simulation of visual scene outside the cockpit, such as the ground scene, the sky scene, the horizon, the space target, the ground target and the day and night changes, etc.

In this paper we have investigated the visual simulation of star scene in a space flight simulator and proposed both theory and method for real-time simulation of the star scene using a planetarium for astronauts training for orbit flight. Using matrix theory and the relative motion of the star scene and the astronaut's line-of-sight in real orbit flight, we have analyzed the composite motion of a three-axle planetarium in real time simulation. Finally, the theory and the proposed method are confirmed with computation, analysis, and experiments.

I. Situation of the Real World

In order to illustrate the relative motion of the star scene and the astronaut's line-of-sight, we introduce the following space coordinate systems and derive the relations among them.

1. Celestial coordinate system (C-system)

The origin of the C-system is at the center of the earth, the z_C axis of the system points toward the north pole and the x_C axis points toward the vernal equinox. The y_C axis is then determined by the right-hand rule.

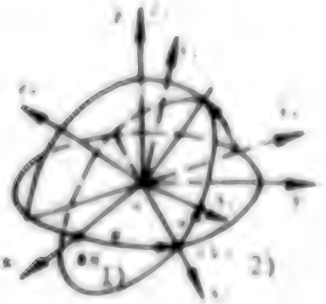
2. Terrestrial (inertial) coordinate system (I-system)

The origin of the I-system is also at the center of the earth. Its z_I axis coincides with the z_C axis and its x_I axis points toward the ascending node. The y_I axis, in the equatorial plane, is determined by the right-hand rule.

Coordinate systems C and I are related by the following equation:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = (\Omega)_z^{-1} \begin{bmatrix} x \\ y \\ z \end{bmatrix} \qquad (1)$$

where $(\Omega)_z^{-1}$ represents the inverse transformation matrix for rotation about the z axis. Ω is the angle between x_C and x_I and it depends on such factors as the earth's self-rotation, the time at which the spacecraft enters the orbit, and the launching location. (see Fig. 1)



Key:
1. Vernal equinox
2. Ascending node

Fig. 1

3. Spacecraft trajectory system (T-system)

The origin of the T-system is also located at the earth center. x_T points toward the center of mass of the spacecraft. z_T is perpendicular to the orbit plane with its positive direction parallel to the angular velocity vector of the spacecraft center of mass in the orbit. The direction of y_T is again determined by the right-hand rule (see Fig. 1).

The T-system is related to the I-system as follows:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_T = L(i)\,L(\omega) \begin{bmatrix} x \\ y \\ z \end{bmatrix}_I \qquad (2)$$

where i is the angle of inclination of the orbit, and ω is the angle swept out by the spacecraft center of mass around the earth center.

4. Spacecraft heading system (H-system)

The origin of the H-system is placed at the center of mass of the spacecraft. x_H is the projection of the spacecraft velocity vector in the local horizontal plane. z_H points from the spacecraft center to the center of earth, i.e., opposite in direction to x_T. The y_H axis is perpendicular to the orbit plane and in the opposite direction of z_T. The H-system is related to the T-system by the following transformations:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_H = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_T \qquad (3)$$

5. Spacecraft body system (B-system)

The origin of the B-system is located at the center of the spacecraft. The x_B axis is the longitudinal axis of the spacecraft with its positive direction points toward the head of the spacecraft. Axis z_B is in the plane of longitudinal symmetry and points downward. The direction of y_B is given by the right-hand rule.

The relationship between the B-system and the H-system is given by:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_B = L(\theta)\,L(\psi)\,L(\phi) \begin{bmatrix} x \\ y \\ z \end{bmatrix}_H \qquad (4)$$

where θ is the pitching angle of the spacecraft, ψ is the angle of deviation and φ is the rolling angle.

6. Astronaut line-of-sight system (LOS-system)

The origin of this system is at the location of the astronaut's eyes and the x_{LOS} axis is the line-of-sight. The y_{LOS} axis is parallel to the horizontal symmetry plane of the spacecraft body and is positive pointing to the right. z_{LOS} is determined by the right-hand rule and is positive pointing downward. Considering the head movements and the eyeballs movements of the astronaut, the B-system can be expressed in terms of the LOS-system:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_B = (\psi_{LOS})_3^{-1} \cdot (\theta_{LOS})_2^{-1} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS} \tag{5}$$

where ψ_{LOS} is the angle of deviation of the line-of-sight with respect to the vertical symmetry plane of the spacecraft, and θ_{LOS} is the pitching angle of the line-of-sight with respect to the horizontal plane of symmetry of the spacecraft body.

7. Transformation between LOS-system and C-system

From Eqs. (1) through (5), we have

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_C = (\Omega)_3^{-1} \cdot (i)_1^{-1} \cdot (\omega)_3^{-1} \cdot \begin{bmatrix} 0 & 0 & -1 \\ 1 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix} \cdot (\theta)_2^{-1}$$

$$\cdot (\psi)_3^{-1} \cdot (\phi)_1^{-1} \cdot (\psi_{LOS})_3^{-1} (\theta_{LOS})_2^{-1} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS} \tag{6}$$

If we let

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_C = [K] \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS} \tag{7}$$

then the elements of matrix [K], k_{ij} (i,j = 1,2,3), are given by

$$\begin{aligned} k_{11} = {} & (c\Omega \cdot c\omega - s\Omega \cdot c\omega \cdot ci) \cdot [c\psi \cdot c\theta \cdot c\theta_{LOS} \cdot c\psi_{LOS} - (c\theta \cdot c\phi \cdot s\psi \\ & - s\theta \cdot s\phi) \cdot c\theta_{LOS} \cdot s\psi_{LOS} - (c\theta \cdot s\phi \cdot s\psi + s\theta \cdot c\phi) \cdot s\theta_{LOS}] \\ & - s\Omega \cdot si \cdot (s\psi \cdot c\theta_{LOS} \cdot c\psi_{LOS} + c\phi \cdot c\psi \cdot c\theta_{LOS} \cdot s\psi_{LOS} + s\phi \cdot c\psi \cdot s\theta_{LOS}) \\ & + (s\Omega \cdot s\omega \cdot ci - c\Omega \cdot c\omega) \cdot [-c\psi \cdot s\theta \cdot c\theta_{LOS} \cdot c\psi_{LOS} + (s\theta \cdot c\phi \cdot s\psi \\ & + s\phi \cdot c\theta) c\theta_{LOS} \cdot s\psi_{LOS} + (s\theta \cdot s\phi \cdot s\psi - c\phi \cdot c\theta) s\theta_{LOS}] \end{aligned} \tag{8}$$

$$\begin{aligned} k_{12} = {} & (-c\Omega \cdot s\omega - s\Omega \cdot c\omega \cdot ci) \cdot [-c\psi \cdot c\theta \cdot s\psi_{LOS} - (c\theta \cdot c\phi \cdot s\psi - s\theta \cdot s\phi) \\ & \cdot c\psi_{LOS}] - s\Omega \cdot si \cdot (c\phi \cdot c\psi \cdot c\psi_{LOS} - s\psi \cdot s\psi_{LOS}) + (s\Omega \cdot s\omega \cdot ci \\ & - c\Omega \cdot c\omega) \cdot [c\psi \cdot s\theta \cdot s\psi_{LOS} + (s\theta \cdot c\phi \cdot s\psi + s\phi \cdot c\theta) \cdot c\psi_{LOS}] \end{aligned} \tag{9}$$

$$\begin{aligned} k_{13} = {} & (c\Omega \cdot c\omega - s\Omega \cdot c\omega \cdot ci) \cdot [c\psi \cdot c\theta \cdot s\theta_{LOS} \cdot c\psi_{LOS} - (c\theta \cdot c\phi \cdot s\psi \\ & - s\theta \cdot s\phi) s\theta_{LOS} \cdot s\psi_{LOS} + (c\theta \cdot s\phi \cdot s\psi + s\theta \cdot c\phi) \cdot c\theta_{LOS}] \\ & - s\Omega \cdot si \cdot (s\psi \cdot s\theta_{LOS} \cdot c\psi_{LOS} + c\phi \cdot c\psi \cdot s\theta_{LOS} \cdot s\psi_{LOS} - s\phi \cdot c\psi \cdot c\theta_{LOS}) \\ & + (s\Omega \cdot s\omega \cdot ci - c\Omega \cdot c\omega) \cdot [-c\psi \cdot s\theta \cdot s\theta_{LOS} \cdot c\psi_{LOS} + (s\theta \cdot c\phi \cdot s\psi \\ & + s\phi \cdot c\theta) \cdot s\theta_{LOS} \cdot s\psi_{LOS} - (s\theta \cdot s\phi \cdot s\psi - c\phi \cdot c\theta) c\theta_{LOS}] \end{aligned} \tag{10}$$

[illegible] (11)

[illegible] (12)

[illegible] (13)

[illegible] (14)

[illegible] (15)

[illegible] (16)

in which c and s stand for cos and sin respectively. Equations (7) through (16) describe the transformation between the astronaut's line-of-sight (LOS-system) and the celestial C-system, that is, they describe the relative motion of the two systems for orbit flights of a spacecraft in the real world. However, if we consider the structural characteristics of the three-axle leveling mechanism of the planetarium and consider the ease for future computations, it is best to represent the above transformation with a set of three characteristic Euler angles. We shall call this transformation the "intuitive transformation."

8. "Intuitive transformation" between LOS-system and C-system

Let the three characteristic Euler angles be A_1, A_2, and A_3, the intuitive transformation is given by

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = (A_{\text{[illegible]}})_{\text{[illegible]}} \cdot (A_{\text{[illegible]}})_{\text{[illegible]}} \cdot (A_{\text{[illegible]}})_{\text{[illegible]}} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{\text{[illegible]}} \qquad (17)$$

Realizing that Eq. (17) is equivalent to Eq. (7), we have

$$A_{\text{[illegible]}} = tg^{-1}(-h_{\text{[illegible]}}/h_{\text{[illegible]}}) \qquad (18)$$

$$A_{\text{[illegible]}} = \begin{cases} \sin^{-1} h_{\text{[illegible]}} \\ \cos^{-1}(h_{\text{[illegible]}}/\cos A_{\text{[illegible]}}) \end{cases} \qquad (19)$$

$$A_{\text{[illegible]}} = tg^{-1}(-h_{\text{[illegible]}}/h_{\text{[illegible]}}) \qquad (20)$$

We can therefore use Eqs. (10) - (13) and Eqs. (16) - (20) in an intuitive realization of the correspondence relationship between the real world LOS-system and the C-system. In the meantime the relationship between the LOS_M-system of the test subject line-of-sight in the simulation room and the simulated celestial C_M-system is revealed.

Based on the above results, we now proceed to discuss the procedure for driving the three-axis planetarium and simulating the star scene in a simulation room.

II. Situation in the Simulation Room

9. Laboratory horizontal coordinate system (D-system)

Assuming the origin is at the "Center" of the laboratory, then the x_D axis is pointing toward west (refering to the "simulated vernal equinox"), the y_D axis is perpendicular to the ground with up being the positive direction, and z_D points toward north (i.e. the "simulated north pole"). The D-system is used as a fixed reference coordinate in the laboratory.

10. Planetarium system (GAO-system) and instantaneous orbit-entry simulated celestial system (C_{MO}-system)

The origin of the GAO-system is at the rotation center of the planetarium. The three axes x_{GAO}, y_{GAO}, and z_{GAO} are respectively the horizontal, the altitude and the sidereal axles of the planetarium.

To satisfy the requirement that x_{LOSM} axis points toward the hemispherical sky screen of the planetarium during the experiment, we let the GAO-system coincide with the C_{MO}-system and, for $k_{21} > 0$ at orbit entry, equate them to the D-system:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{GAO} = E \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_{MO}} = E \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{D} \qquad (81)$$

where E is unit matrix.

For $k_{21} < 0$ at the instance of orbit entry, the three systems are related in the following way:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{GAO} = E \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_{MO}} = \text{[illegible]} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{D} \qquad (82)$$

11. Orientation of the simulated line-of-sight system (LOS_M-system)

If we use (u,q) in the specification of the x_{LOSM} axis (see Fig. 2), then u and q can be expressed as follows

$$u = tg^{-1}(h_{\text{[illegible]}}/h_{\text{[illegible]}}) \qquad (23)$$

$$q = tg^{-1}(h_{\text{[illegible]}}/\sqrt{h^2_{\text{[illegible]}} + h^2_{\text{[illegible]}}}\,) \qquad (24)$$

Similarly we can use (u_I, q_I) to specify the z_{LOSM} axis where

$$u_I = tg^{-1}(h_{\text{[illegible]}}/h_{\text{[illegible]}}) \qquad (25)$$

$$q_I = tg^{-1}(h_{\text{[illegible]}}/\sqrt{h^2_{\text{[illegible]}} + h^2_{\text{[illegible]}}}\,) \qquad (26)$$

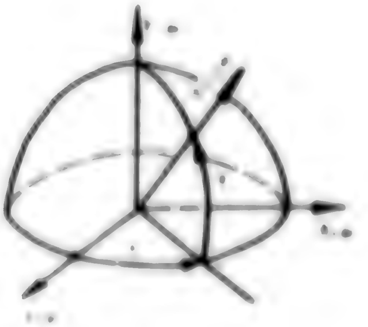


Fig. 2

Thus, the simulated line-of-sight system (LOS_M) at the entry time is specified in the laboratory with respect to the simulated celestial system (C_{MO}-system or GAO-system). Hereafter, the relative position changes of the LOS-system and the C-system in the real world for any instance of time after orbit entry are represented by the relative motion of the LOS_M-system and the C_M-system in the simulation room.

Since the orientation of the LOS_M-system is "fixed" in the simulation experiment, all the relative motions of the C_M-system with respect to the LOS_M-system must be achieved by driving the leveling frame of the planetarium. We therefore introduce a GA-system, defined below, that commands the motion of the C_M-system.

12. GA-system and C_M-system

Based on the simulation principle, if we let the GA-system coincide with the C_M-system, then the relative orientation of C_M-system at any time instance after orbit after entry with respect to the C_{MO}-system is given by the relative orientation of the GA-system with respect to the GAO-system.

We assume the following relation exist between the GAO-system and the GA-system:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} = E\cdot\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} = (\gamma)_3\cdot(\beta)_1\cdot(\alpha)_3\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS_{MO}} \qquad (27)$$

where α, β, and γ are three variables closely related to the orbit motion and the attitude motion of the spacecraft. In the following section we shall derive analytical expressions for them.

13. Analytical expressions of α, β, and γ

From Eq. (17), we have

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS-M_O} = (A_{10})_3^{-1}\cdot(A_{20})_1^{-1}\cdot(A_{30})_3^{-1}\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} \qquad (28)$$

where A_{10}, A_{20}, and A_{30} are the three characteristic Euler angles at the instance of orbit entry. Based on the definitions of the LOS-system, the C-system, and the C_M-system, and using symmetry relation, we can write down the transformation between the LOS_{MO}-system and the C_M-system:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C} = E\cdot\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} = (A_3)_3\cdot(A_2)_1\cdot(A_1)_3\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS-M_O} \qquad (29)$$

Using Eqs. (28) and (29), we have the following transformation between the LOS_{MO}-system and the C_M-system:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C} = E\cdot\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} = (A_3)_3(A_2)_1(A_1)_3(A_{10})_3^{-1}(A_{20})_1^{-1}(A_{30})_3^{-1}\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} \qquad (30)$$

Let

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C} = [p]\cdot\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} \qquad (31)$$

where p_{ij} (i,j = 1,2,3) are the elements of matrix [p]:

$$\begin{aligned} p_{11} = {} & (cA_1cA_3 - sA_1sA_2sA_3)\cdot(cA_{10}cA_{30} - sA_{10}sA_{20}sA_{30}) + (cA_1sA_3 \\ & + sA_1sA_2cA_3)\cdot(cA_{10}sA_{30} + sA_{10}sA_{20}cA_{30}) + cA_2\cdot sA_1\cdot cA_{20}\cdot sA_{10} \end{aligned} \qquad (32)$$

$$\begin{aligned} p_{12} = {} & (cA_1cA_3 - sA_1sA_2sA_3)\cdot(-cA_{20}sA_{30}) + (cA_1sA_3 + sA_1sA_2cA_3) \\ & (cA_{20}cA_{30}) - cA_2\cdot sA_1\cdot sA_{20} \end{aligned} \qquad (33)$$

$$\begin{aligned} p_{13} = {} & (cA_1cA_3 - sA_1sA_2sA_3)\cdot(sA_{10}cA_{30} + sA_{30}cA_{20}sA_{10}) + (cA_1sA_3 \\ & + sA_1sA_2cA_3)\cdot(sA_{10}sA_{30} - sA_{30}cA_{20}cA_{10}) - cA_2\cdot sA_1\cdot cA_{20}\cdot cA_{10} \end{aligned} \qquad (34)$$

$$\begin{aligned} p_{21} = {} & (-cA_2sA_3)\cdot(cA_{10}cA_{30} - sA_{10}sA_{20}sA_{30}) + (cA_2\cdot cA_3)\cdot(cA_{10}sA_{30} \\ & + sA_{10}sA_{20}cA_{30}) + sA_2(-cA_{20}sA_{10}) \end{aligned} \qquad (35)$$

[illegible] (36)

[illegible] (37)

[illegible] (38)

[illegible] (39)

[illegible] (40)

In Eqs. (32) - (40), c and s represent cos and sin respectively. A_{10}, A_{20}, and A_{30} are the three characteristic Euler angles at orbit-entry and A_1, A_2, and A_3 are the Euler angles at a given time after orbit entry.

Comparing Eqs. (27 and (31), we have

$$\alpha = \mathrm{tg}^{-1}(\rho_{[illegible]}/\rho_{[illegible]}) \qquad (41)$$

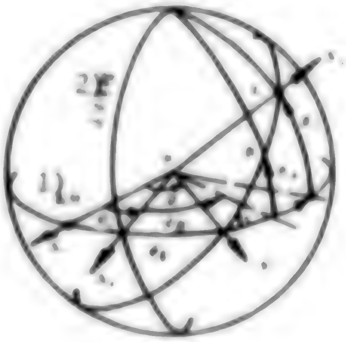
$$\gamma = \mathrm{tg}^{-1}(\rho_{[illegible]}/\rho_{[illegible]}) \qquad (42)$$

$$\beta = \begin{cases} \sin^{-1}(-\rho_{[illegible]}) \\ \cos^{-1}(\rho_{[illegible]}/\cos\alpha) \end{cases} \qquad (43)$$

Thus, when the horizontal axle of the planetarium is rotated from 0 to angle α, the altitude axle is rotated from 0 to angle β and the sidereal axle is rotated from 0 to angle γ, the position of the simulated celestial C_M-system displayed by the planetarium agrees exactly with the star scene observed by the astronaut at that instance of time in the real world. To facilitate the experimental confirmation of the above theory and the training of astronauts, we compile the following "star belt chart".

14. Compilation of the "star belt chart"

With the aid of Fig. 3, we can write down the "direct ascent" ψ_L and "declination" θ_L for the center of the spacecraft:



Key:
1. Vernal equinox
2. Principal meridian

Fig. 3

$$\psi_s = \Omega + \sin^{-1}(\mathrm{tg}\,\theta_s \cdot \mathrm{ctg}\,i) \qquad (44)$$

$$\theta_s = \sin^{-1}(\sin i \cdot \sin \omega) \qquad (45)$$

where,

$$\Omega = \psi_B + \psi_g - \sin^{-1}(\mathrm{tg}\,\theta_B \cdot \mathrm{ctg}\,i) \qquad (46)$$

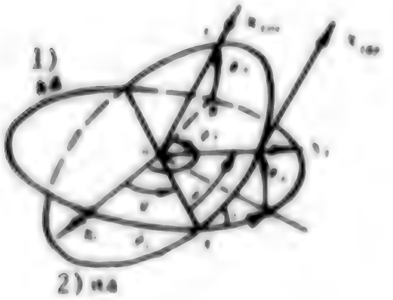
$$\psi_g = \mathrm{tg}^{-1}[\mathrm{tg}(360d/365) \cdot \cos 23.5^\circ] + 15T \qquad (47)$$

$$\omega = \omega_0 + \int \dot{\omega}\, dt \qquad (48)$$

$$\omega_0 = \sin^{-1}(\sin \theta_B / \sin i) + 360 \cdot \widehat{BL} / \pi \cdot R_E \qquad (49)$$

in which ψ_B and θ_B are respectively the longitude and latitude of the launching site. Point B is the launch site, point L is the subastral point of the orbit entry point, and $\widehat{BL}$ is the horizontal distance between launch site and orbit entry point. ω is the orbit rotation angle of the spacecraft center measured from the ascending node, ψ_E is the angle measured from vernal equinox to the principal meridian (i.e. Greenwich sidereal time), d is the number of days from the 21st of March, T is the orbit entry time of the day and R_E is the radius of the earth.

Similarly, using Fig. 4, we can specify the "direct ascent"



Key:
1. Equator
2. Orbit

Fig. 4

ψ_x and the "declination" θ_x of the line-of-sight x_{LOS} at any time as follows

$$\psi_x = \Omega + \mathrm{tg}^{-1}(\cos i / \mathrm{ctg}\,\mu) \qquad (50)$$

$$\theta_x = \sin^{-1}(\sin i \cdot \sin \mu) \qquad (51)$$

where

$$\mu = 90^\circ - \omega - \theta - \theta_{LOS(p)} \qquad (52)$$

and $\theta_{LOS(p)}$ is the projection of θ_{LOS} on the orbit plane.

Using the computed values of instantaneous ψ_x and θ_x and consulting astronomical data such as astronomy annuals, star catalog and star map, we obtain the constellation, star name and star magnitude observable by line-of-sight x_{LOS} at a given time. A star belt chart can thus be compiled as follows:

t	ψ_x	θ_x	Constellation	Star name	Star magnitude
0	73°5'49"	14°4'20"	Tau	α	1
150	80°17'41"	7°5"	ori	γ	1
⋮	⋮	⋮	⋮	⋮	⋮

Note: Width of the "star belt" is determined by the actual field of view from the window

III. Confirmation Methods

15. Simple computational confirmation

Using concepts of solid geometry, we realize that the following relations exist between ψ_x, θ_x and matrix [K]:

$$\psi_x = \mathrm{tg}^{-1}(k_{..}/k_{..}) \tag{53}$$

$$\theta_x = \mathrm{tg}^{-1}(k_{..}/\sqrt{k_{..}^2 + k_{..}^2}) \tag{54}$$

However, ψ_x and θ_x are also related to u and q:

$$\psi_x = \mathrm{ctg}^{-1}(\sin u/\mathrm{tg}\, q) \tag{55}$$

$$\theta_x = \sin^{-1}(\cos u \cdot \cos q) \tag{56}$$

The expressions for ψ_x and θ_x derived from different methods should be identical, that is,

(50)=(53)=(55)

(51)=(54)=(56)

On the other hand, Λ_1, Λ_2, Λ_3, α, β, and γ should satisfy the following identities:

$$(A_1)_\cdot(A_2)_\cdot(A_3)_\cdot = [K] \tag{57}$$

$$(\gamma)_\cdot(\beta)_\cdot(\alpha)_\cdot = [P] \tag{58}$$

If the computed results satisfy the identities in Eqs. (57) and (58), the calculations are correct; otherwise, there are errors in the calculations.

16. Experimental confirmation

According to the transformation

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{...} = (A_1)_\cdot(A_2)_\cdot(A_3)_\cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{...} \tag{59}$$

after the three angular movements A_3, A_2 and A_1 in GAO-system, the north pole on the display doom represents the direction of z_{LOSM} and the vernal equinox represents the direction of x_{LOSM}. The first step is to "mark" x_{LOS} on the screen. The planetarium is then returned to the original position in the GAO system. The star position indicated by the "mark" is the star position aimed by x_{LOS} at this time. This is then recorded. In the second step, the LOS_{MO}-system is first determined and then, using the transformation

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_{C_M} = (\gamma)_z \cdot (\beta)_x \cdot (\alpha)_z \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix}_{LOS_{MO}} \qquad (80)$$

the three angular movements α, β, and γ are executed in the GAO-system according to the experimental situation. The scene displayed on the doom is the C_M-system configuration.

Now observe the C_M-system from the fixed $x_{LOS_{MO}}$ direction, the star positions observed should be identical to those in the first step and in agreement with the "star belt chart". Naturally, the position of z_{LOSM} should be noted in the experiment.

Conclusions

We have made extensive computational confirmation for the mathematical model and the simulation theory presented in this paper. We have confirmed the results with experiments as well. The methods and model are entirely correct and suitable for space-flight visual simulation with closed-circuit television in broadcasting the star scene.

When a spacecraft module is directly installed in the star scene simulation room for the direct observation of the star scene by the astronaut through the module window, there will be the problem of adjusting the attitude of the heavy space module for flight simulation in different orbits. This problem calls for further investigation.

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SPACE SCIENCE JOURNAL CALLS FOR CONTRIBUTIONS

Call for Papers

Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 1, 1980 p 107

[Trial Draft of Call for Papers by the JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS]

[Text] (1) YUHANG XUEBAO is an academic journal published by the Chinese Society of Astronautics.

(2) Under the guidance of Marxist-Leninism and Mao Zedong Thought, the policies of this journal are to have all schools of thoughts in broadening academic exchange and discussion, to promote the development of astronautic science and technology, and to contribute to the realization of the Four Modernizations.

(3) The journal solicits and publishes paper on theories of space flight, astronautic engineering technology (including spacecraft, dynamic system, control system, launching spacecraft, dynamic system, control system, launching facility, experimental apparatus and measurement equipment), space physics, space electronics and space medicine and biology. Categories suitable for publication in this journal are:

1. Academic papers that are innovative in theory, in practice, or in a combination of both.

2. Technical reports on the achievements of successful research and developments that reflect today's advanced technical standard.

3. Reviews or comments on a certain theory or technique.

4. Reports on foreign or domestic developments in astronautic science and technology.

(4) Readers of this journal consist mostly of astronautic science researchers, engineers and technical personnel, faculty members of universities and colleges, and senior level students.

(5) Rules for submitting manuscripts:

1. The paper submitted should have a prominent subject and concise and complete arguments. Data presented should be reliable and the presentation should be lucid and clear. Papers should not exceed 10,000 words and technical reports should not exceed 5,000 words. Papers should be preceeded by a Chinese language abstract of no more than 300 words companied by an English translation of the abstract.

2. Two copies of the manuscript are required. Manuscripts should be neatly and clearly printed with pen on one side of the paper only.

3. Figures should meet drafting requirements. Legends in the figures should be written with pencil. Locations for figures should be blocked out in the manuscript with figure number and figure caption clearly indicated. Photographs of real objects must be clear and have good contrast.

4. Foreign words and notations in the paper should be standard and unambiguous. Wiggly underlines should be added where boldface letters are required.

5. All references should appear at the end of the article in the following format:

(Reference number), authors' names, name of journal or book, volume and issue numbers, page number, publisher, place, and date.

(6) Authors should provide full names, organizational affiliation, professional title and address. If the manuscript has been submitted elsewhere, please so indicate.

(7) For accepted manuscripts, the authors will receive compensation. Authors should keep a copy of the manuscript; generally they will not be returned.

(8) Please send manuscripts to: Editor, YUHANG XUEBAO, Post Office Box 848, Beijing.

Call for Insignia Pattern Design

Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 1, 80 p 108

[Text] In view of the foreign and domestic communication needs, the Chinese Society of Astronautics is soliciting an insignia pattern design. The design should meet the following requirements:

1. The insignia pattern should reflect the astronautic science and technology and the society as an academic organization.

2. The insignia design should be

(1) Simple and appealing,
(2) Suitable for making into an emblem,
(3) Suitable for producing embossed metal casting,
(4) Suitable for making copies and replicas.

3. Insignia design should follow national drafting standards. Drawing should be made with black ink on translucent tracing paper. Dimensions should be indicated clearly. Colored oversize pattern should also be provided.

4. Designs can be sent to the Chinese Society of Astronautics, Post Office Box 848, Beijing. The envelope should be marked "Insignia Pattern." Submitted designs will not be returned.

5. The deadline for submission is December 31, 1980. For the insignia design adopted by the society, the designer will receive compensation.

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Aeronautics

AUTHOR: ZHU Pengfei [2612 7720 7378]

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TITLE: "Rocket-Ramjet Engine"

SOURCE: Beijing HANGKONG ZHISHI [AEROSPACE KNOWLEDGE MAGAZINE] in Chinese No 2, Feb 81 pp 10-12

ABSTRACT: By combining the principles of ramjet engine and rocket engine, it is possible to design a propulsion system with high thrust to weight ratio, high specific impulse, and good fuel economy. Such propulsion systems have been used on the Soviet SAM-6 missile and certain U.S. tactical missiles. The structure of a solid propellant rocket-ramjet engine has three basic components: the supersonic inlet duct, the ejector, and the rocket engine. During the operation of a solid rocket-ramjet engine, the rocket engine is ignited first to provide initial acceleration; when the missile reaches sufficiently high velocity the ramjet engine begins to function and the rocket nozzle is discarded. Compared with a conventional rocket engine or a ramjet engine with similar performance, the rocket-ramjet engine is smaller in size, lighter in weight, and does not require complicated fuel supply system or ignition system.

AUTHOR: None

ORG: None

TITLE: "Remote Sensing Anti-Armor Bomb"

SOURCE: Beijing HANGKONG ZHISHI [AEROSPACE KNOWLEDGE MAGAZINE] in Chinese No 2, Feb 81 pp 18-19

ABSTRACT: The remote sensing anti-armor bomb is a weapon developed by the United States to defend against the increasing number of armored vehicles of the Warsaw Pact nations. The weapon is generally deployed in the form of a mother-daughter package, each mother bomb carrying two or three daughter bombs. The main components of a daughter anti-armor bomb consist of a millimeter-wave sensing device, a warhead, a vortex-ring parachute, a signal processor, a power source, and safety mechanism. After being delivered to the target zone, the daughter bomb relies on its remote sensor to search out individual targets and detonate in mid-air to destroy personnel inside the armored vehicles.

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ORG: None

TITLE: "Chinese Civil Aviation and the Y10 Airplane"

SOURCE: Beijing HANGKONG ZHISHI [AEROSPACE KNOWLEDGE MAGAZINE] in Chinese No 2, Feb 81 pp 20-21

ABSTRACT: This is a translated article originally published in the British weekly magazine "Flight International". This article reviews the current status of civil aviation in China, and presents certain statistical data such as the number and types of passenger airplanes in service, the number of repair and maintenance facilities for civilian airplanes, the number of passenger flights per year over the past decade, the capacity and facilities at the new Peking airport and the Shanghai civilian airport. In addition, progress in the development of the first Chinese-made passenger airplane, the Y10, is also reviewed. The Y10 is a four-engine airplane which has been under development since 1972. It is somewhat smaller than the Boeing 707-320C and is capable of carrying 120 passengers. Currently, three prototype Y10 airplanes have been built for test purposes. The first scheduled flight of the Y10 is expected to take place later this year.

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AUTHOR: WU Youshou [0702 0147 1108]

ORG: Qinghua University

TITLE: "Progress in Integrated Single Line PCM Coder"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 pp 2-8

ABSTRACT: PCM [Pulse Code Modulation] is an extensively used method of coding for the digital telephone communication system. The method was proposed for telephone as early as the 30's and it was proved to resist interference, suitable for long distance relay communication, and convenient for maintaining secrecy. Due to instrumental limitations, its development for practical application had always been slow, however. In the 50's the Bell Laboratories made an experimental PCM equipment using electron beam coding tubes. The circuit was too complex; the power consumption was too high, the reliability was very poor; therefore, it was not extended. It was not until the rapid advancement of semiconductor and digital technologies before these problems were gradually resolved. Aside from a detailed explanation of the past problems and current advancements in PCM application, the paper also discusses briefly the outstanding problems. Although China's communications industry remains backward, the author believes that attention should be given to PCM to prepare for future modernization needs.

AUTHOR: HUANG Yaoxian [7806 5069 0341]

ORG: Beijing Chunshu Rectifier Plant

TITLE: "Special Silicon Controlled Rectifier [SCR] and Its Application"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 pp 13-16

ABSTRACT: Power semiconductor devices are the most familiar SCR and they are being applied in all realms of the national economy. Regarding application, they may be divided into (1) AC DC switch; (2) Phase control (or controlled rectifier); (3) Reverse variable or variable frequency, etc. These applications require SCR of different parameters, which may even be mutually contradictory. For this reason, many special SCM's are being developed to meet each of the many requirements, such as rapid SCR, switch-controlled SCR, reverse-conduction SCR, etc. Major characteristics and primary applications of each of these special SCR's are explained in separate sections in the paper.

AUTHOR: SHAO Tinghong [6730 8126 3163]

ORG: Beijing Broadcasting Materials Plant

TITLE: "Testing Circuit for Large Power Switch Transistor Switching Time"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 pp 22-23

ABSTRACT: With the growing applications of large scale integrated circuits and power semiconductor devices, switch power sources of small size, light weight, high efficiency, low voltage, and large capacity have been studied and extensively used. The key device of the switch power source, the large power switch transistor, is already being manufactured by some domestic component plants. There remains no reasonable and practical method of testing the important special parameters of the switch transistor, however, including the conduction time T_{on}, the cut-off time T_{off}, etc. In the process of studying the switch power source, the author and colleagues designed a test circuit made from components made in China to test these parameters. The test circuit was used to test the cut-off time of 20 products [all made in China ?] to determine their switch times. The test results are listed in a table included in the paper.

AUTHOR: ZENG Qingcheng [2582 1987 1004]

ORG: Jiangxi University

TITLE: "Electrolytic Water Oxidation Microscopy"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 pp 29-30, 20

ABSTRACT: In the process of manufacturing semiconductors, the quality of the device is closely related to the quality of the core chip; therefore, it is necessary to strengthen the inspection, monitor, and control of the core chip. The currently commonly used methods include the chemical staining method using the $CuSO_4$ solution or the HNO_3-HF solution. These 2 methods are not satisfactory either for detecting $P-P^+$ or $N-N^+$ foreign matter density distribution or for being too toxic and dangerous. This paper introduces the theory and procedure of the electrolytic water oxidation microscopic method. Its many advantages are explained.

AUTHOR: WANG Shuzhang [3769 2885 3864]
ZHANG Jingyan [1728 2529 3601]

ORG: None

TITLE: "Front Cover Explanation"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 p 38

ABSTRACT: The first color television assembly line introduced to China has been established in the State-operated Tianjin Radio Plant and the test operation has started. This assembly line is designed on the basis of the assembly line in Shengli Company [transliteration] of Japan with considerations of the conditions in China. It is designed to assemble either 14-inch or 22-inch color televion sets, with a production capacity of 500 sets per day. The front cover of this issue of the journal is a photo taken by the authors to depict the workers carefully adjusting Beijing-823 14-inch color television sets on the assembly line.

AUTHOR: LU Jiahe [7120 1376 0735]

ORG: None

TITLE: "Laser Mode-Locking Technique and Its Application"

SOURCE: Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 1, Jan 81 pp 39-40

ABSTRACT: In laser technology, mode-locking is a very important technique. The Bell Telephone Laboratories of the USA was the first to study the laser mode-locking phenomenon and the first report was published in 1964. The study on the application of laser mode-locking did not begin until the middle 70's, however. It was then that the researchers began to recognize the extreme significance of the high peak power within a super-short time produced by the laser through mode-locking. There are many reports of practical applications of laser mode-locking. The relatively more important ones are laser controlled thermonuclear fusion, precision long distance range finding, optical communication, laser holography, etc. The technique of mode-locking and actual applications of the technique in Japan and the USA are introduced.

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